CERTIFICATE OF VERIFICATION

I, Su Hyun LEE of 648-23 Yeoksam-dong, Kangnam-ku, Seoul, Korea state that the attached document is a true and complete translation to the best of my knowledge of the Korean-English language and that the writings contained in the following pages are correct English translations of the specifications and claims of the Korean Patent Publication No. P2000-31956.

Dated this 10th day of January 2005

Signature of translator: ____________________

Su Hyun LEE

[ABSTRACT OF THE DISCLOSURE]

[ABSTRACT]

Transverse electric field type LCD includes a first substrate and a second substrate, a data electrode, common electrode and common electrode lines formed on the first substrate, a gate-insulating layer formed thoroughly on the first substrate over the data electrode and the common electrode and has data holes within the data electrode, a storage electrode formed on the gate-insulating layer to overlap over the common electrode lines or the common electrodes, a protective film formed thoroughly on the first substrate over the storage electrode, having a hole formed at a position correspondingly to the data holes and a storage hole within the storage electrode area, a connection electrode formed on the protective film to cover the data and storage holes formed thereon and electrically connecting between the data electrode and the storage electrode, and a liquid crystal layer formed between the first and the second substrates. In the above structure, the common electrode and the data electrode are made of the same material for the same layer, whereby a space between two electrodes are in regular and a regularity of CD is obtained so as to apply regular transverse field to the liquid crystal layer. Accordingly, a high quality image without being colored is obtained.

[TYPICAL DRAWING]

FIG. 3

[SPECIFICATION]

[TITLE OF THE INVENTION]

TRANSVERSE ELECTRIC FIELD TYPE LCD AND METHOD OF FABRICATION THE SAME

[BRIEF DESCRIPTION OF THE DRAWINGS]

FIG. 1 is a plan view illustrating a first substrate of a related art transverse electric field type LCD;

FIG. 2 is a cross-sectional view taken along with the line A-A' of FIG. 1;

FIG. 3 is a plan view illustrating a first substrate of a transverse electric field type LCD in accordance with a first preferred embodiment of the present invention;

FIG. 4 is a cross-sectional view taken along with the line B-B' of FIG. 3;

FIG. 5 is a cross-sectional view taken along with the line C-C' of FIG. 3;

FIG. 6 is a cross-sectional view taken along with the line D-D' of FIG. 3;

FIG. 7 is a plan view illustrating a transverse electric field type LCD in accordance with a second preferred embodiment of the present invention; and

FIG. 8 is a plan view illustrating a transverse electric field type LCD in accordance with a third preferred embodiment of the present invention.

[DETAILED DESCRIPTION OF THE INVENTION]

[OBJECT OF THE INVENTION]

[FIELD OF THE INVENTION AND DISCUSSION OF THE RELATED ART]

The invention relates to a liquid crystal display device(LCD), and more particularly, to a transverse electric field type liquid crystal display and fabrication method of the same device and a method of fabricating the same.

Recently, there are strong requirements in thin film transistor liquid crystal layers (TFT LCD) being widely used in portable television or notebook computer to be

strongly larger, but there remains a problem of variation in contrast ratio of viewing angle in the TFT LCD. To resolve the above problem, various types of liquid crystal displays such as a twisted nematic (TN) mode liquid crystal display device in which a light compensated plate is mounted and multi-domain liquid crystal display device are introduced. However, these kinds of liquid crystal display devices could not completely overcome the problems of deterioration in the contrast ratio or variation in color.

To realize an optical viewing angle, a transverse electric field type liquid crystal display device having an arrangement of a liquid crystal adjusted in accordance with a an electric field parallel to a substrate of the device.

FIG. 1 and FIG. 2 are respectively a plan view and a sectional view of substrates of a related art transverse electric field type LCD, and FIG. 2 is a cross-sectional view taken along with the line A-A' of FIG. 1. Referring to FIGS. 1 and 2, gate bus lines 1 and data bus lines 2 are formed on a first substrate 10 to divide the substrate in plurality of pixels. In drawings, only one pixel will be described for convenience. Common electrode lines 3 are arranged in parallel to the gate bus lines 1 and a thin film transistor consisted of a gate electrode 5, gate-insulating film 12, semiconductor layer 15, source electrode 6 and a drain electrode 7 is formed at a cross point where the gate bus lines 1 and the data lines 2 are intersected with each other. Within a pixel are formed a data electrode 8 and a common electrode 9 in parallel to the data bus lines 2. The data electrode 8 has a certain area where the common bus lines 3 overlap and the common electrode 9 ensuring a formation of a cumulative capacity. A protective film 13 is additionally formed over the common electrode 9 is connected with the data electrode 8 and the gate-insulating film 12.

A color filter 21 is placed on a second substrate 20 and liquid crystal layer 22 is formed between the first and second substrates 10 and 20.

Also, although not shown in drawings, a polarizer for linearly polarizing light for penetrating a side surface of the first and second substrates 10 and 20, and in inner surface between the first and the second substrates 10 and 20 is formed an orientation film adjacent to the liquid crystal so as to determine an orientation direction of a liquid crystal.

The aforementioned transverse electric operates in that a transverse electric field parallel to the first and second substrates 10 and 20 is generated between the data electrode 8 and the common electrode 9 when power is applied from an external driving circuit. Accordingly, molecular axes of liquid crystal oriented in a liquid crystal layer 22 are rotated in a plane parallel with the first substrate by the transverse electric field, to thereby control light transmissivity of the liquid crystal layer 22. Herein, since grey scale is driven with a state the liquid crystal molecule is parallel to the substrate, the difference in light transmissivity depended upon the viewing angle is reduced.

However, in the related art transverse electric field type liquid LCD, the data electrode 8 and the common electrode 9, for applying electric field to the liquid crystal layer, are formed at different layers, respectively, that an alignment of electrodes are disturbed, when the common bus lines overlap the common electrode, during the formation of the gate, source and the drain electrodes, which results in an irregularity of distance between the data electrode and the common electrode. Hence, the difference in the distance between such electrodes renders different electric fields be applied to the liquid crystal between the electrodes, so that the alignment of the liquid crystal is not yielded in a preferred condition.

Also, with the above LCD structure, the larger the size of the screen becomes, the more irregularity in CD is found, which will make the distance between the data and the common electrode irregular, and thereby creating black spots on a screen.

[TECHNICAL TASKS TO BE ACHIEVED BY THE INVENTION]

Accordingly, the present invention is directed to a transverse electric field type liquid crystal display and a method for manufacturing the same that substantially obviates one or more of the problems due to limitations and disadvantages of the related art.

An object of the present invention is to provide a transverse electric field type liquid crystal display in which a data electrode and a common electrode are composed of same material and formed at the same layer, which enhances regularity in CD, thereby preventing any black spots on a screen but yielding high quality images.

To achieve these and other advantages and in accordance with the purpose of the present invention, as embodied and broadly described, a transverse electric field type LCD includes a first substrate and a second substrate, a data electrode, common electrode and common electrode lines all being formed on the first substrate, a gate-insulating layer formed thoroughly on the first substrate over the data electrode and the common electrode and has data holes formed within the data electrode, a storage electrode formed on the gate-insulating layer to overlap over the common electrode lines or the common electrodes, a protective film formed thoroughly on the first substrate over the storage electrode, having a hole formed at the same position corresponding to the data holes and a storage hole formed within the storage electrode area, a connection electrode formed on the protective film to cover the data and storage holes formed thereon and electrically connecting between the data electrode and the storage electrode, and a liquid crystal layer formed between the first and the second substrates.

It is preferable that the common electrode and the data electrode are selected from a group consisting of aluminum (Al), chromium (Cr), tantalum (Ta), aluminum

alloy (Al alloy) or indium tin oxide (ITO).

It is preferable that the connective electrode is communicated with the data electrode through a data hole and with the storage electrode through a storage hole, and it is composed of a transparent material such as an indium tin oxide (ITO).

In another aspect of the present invention, there is provided a method of fabricating a traverse electric field type liquid crystal display device including steps of: forming a first and a second substrate; forming common bus lines, common electrodes and data electrode by patterning the first substrate on which a transparent metallic film is deposited; forming a first gate-insulating layer thereover; depositing another transparent metallic film on the first substrate on which the gate-insulating layer is applied, patterning the same and forming a storage electrode thereafter; forming a second gate-insulating layer thereover; etching partially the storage electrode area of the second gate-insulating layer to form the storage hole and thereafter etching partially the data electrodes of the first and the second gate-insulating layers to form data holes; depositing electricity conductive material on the second gate-insulating layer, patterning the same to form a connective electrode for covering the data holes and the storage holes; and forming a liquid crystal layer by injecting liquid crystal between the first and the second substrates.

It is preferable that the connective electrode is composed of a transparent conductive material such as an indium tin oxide (ITO).

In a second embodiment of the present invention, a transverse electric field type LCD includes a first substrate and a second substrate, a data electrode, common electrode and common electrode lines all being formed on the first substrate, a first gate-insulating layer formed thoroughly on the first substrate over the data electrode and the common electrode and has data holes formed within the data electrode, a second

gate-insulating layer formed over the first gate-insulating layer and has a hole at the same position of the data hole, a connective electrode formed to partially overlap the common electrode and the common bus lines and formed on the second gate-insulating layer so as to cover the data hole, and a liquid crystal layer sandwiched between the first and the second substrates.

In a third embodiment of the present invention, a transverse electric field type LCD includes a first substrate and a second substrate, a data electrode, common electrode and common electrode lines all being formed on the first substrate, a first gate-insulating layer formed thoroughly on the first substrate over the data electrode and the common electrode and has data holes formed within the data electrode, a storage electrode formed on the gate-insulating layer to overlap over the common electrode lines or the common electrodes and covers the data holes to be connected to the data electrode, and a liquid crystal layer sandwiched between the first and the second substrates.

In the above structure, the common electrode and the data electrode are made of the same material for the same layer, whereby a space between two electrodes are in regular and a regularity of CD is obtained so as to apply regular transverse field to the liquid crystal layer. Accordingly, a high quality image without being colored is obtained.

[PREFERRED EMBODIMENTS OF THE INVENTION]

Referenced will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

FIG. 3 is a plan view illustrating a first substrate of a transverse electric field type LCD in accordance with a first preferred embodiment of the present invention, FIG. 4 is a cross-sectional view taken along with the line B-B' of FIG. 3, FIG. 5 is a cross-sectional view taken along with the line C-C' of FIG. 3 and FIG. 6 is a cross-sectional

view taken along with the line D-D' of FIG. 3.

As shown in the above figures, gate bus lines 101 and data bus lines 102 are formed on a first substrate 110 to divide the substrate in plurality of pixels. However, it the enclosed drawing, only one pixel is described for convenience. Common electrode lines 103 are arranged in parallel with the gate bus lines 101 and a thin film transistor consisted of a gate electrode 105, gate-insulating film 112, semiconductor layer 115, source electrode 106 and a drain electrode 107 is formed at a cross point where the gate bus lines 101 and the data lines 102 are intersected with each other. Within a pixel are formed a common electrode 109 which is integrally formed with the common bus lines 103 parallel with the gate bus lines 101.

The above-mentioned in-plane switching mode active matrix type liquid crystal display device accomplishes the above-mentioned first to third objects. Specifically, the in-plane switching mode active matrix type liquid crystal display device which (a) prevents vertical cross-talk without reduction in an aperture ratio, in which (b) the data line is overlapped by the transparent electrode electrically connected to the common electrode, and the common electrode could have a reduced resistance, and which (c) is capable of narrowing a light-impermeable film such as a black matrix film which was used in a conventional IPS mode liquid crystal display device to prevent vertical cross-talk, which is generated due to a leaked electric field, from appearing in a displayed image.

As illustrated in FIG. 2, if the black matrix layer 17 has a width smaller than a width of the data line 24, it would be possible to make use of all light passing through extensions of the transparent common electrode 26 overlapping the data line 24, ensuring enhancement in a ratio at which a light passes through a panel.

It is preferable that the black matrix layer is formed on the second substrate, and

the black matrix layer facing the data lines has a width equal to or greater than 6 [mu]m.

If the black matrix layer had a width smaller than 6 [mu]m, much light reflects at the data line 24, resulting in that a screen of the in-plane switching mode active matrix type liquid crystal display device is hard to be seen under bright circumstance.

It is preferable that the black matrix layer overlaps the scanning line and a region therearound, and an area sandwiched between the scanning line and the pixel electrode and a region therearound.

This ensures that the scanning line, the region and the area can be shielded from light by the black matrix layer.

It is preferable that the pixel electrode is composed of transparent material.

The pixel electrode composed of transparent material would further enhance an aperture ratio.

It is preferable that the common electrode and the pixel electrode are formed in a common layer.

Thus, it would be possible to form the common and pixel electrodes in a single step, ensuring enhancement of a fabrication yield, or the in-plane switching mode active matrix type liquid crystal display device in accordance with the present invention can be fabricated without an increase in the number of fabrication steps.

The in-plane switching mode active matrix type liquid crystal display device may further include an interlayer insulating layer formed in a layer located immediately below the common electrode, and a pixel auxiliary electrode comprised of a single or a plurality of layer(s) formed below the interlayer insulating layer, wherein the pixel auxiliary electrode is preferably electrically connected to the source electrode, and kept at a voltage equal to a voltage of the pixel electrode. The pixel auxiliary electrode is preferably composed of opaque metal.

Though the pixel auxiliary electrode composed of opaque metal slightly reduces transmissivity, it would be possible to form storage capacities above and below a pixel by electrically connecting the pixel electrode to one another through the pixel auxiliary electrode, ensuring higher storage capacitance and higher quality in displaying images.

It is preferable that the pixel auxiliary electrode is at least partially formed below the pixel electrode formed in a layer in which the common electrode is formed, and having a plurality of comb-teeth.

Since an electric field is vertically applied to liquid crystal immediately above the transparent pixel electrode, the liquid crystal vertically stands with the result of reduction in light transmissivity in comparison with light transmissivity obtained in an area between comb-teeth electrodes. Accordingly, it would be possible to electrically connect the pixel auxiliary electrodes located at opposite sides of a pixel, to each other without much reduction in an efficiency at which a light is used, by locating the pixel auxiliary electrode composed of opaque material, just below the pixel electrode having a slightly smaller transmissivity than that of the pixel auxiliary electrode.

It is also preferable that the in-plane switching mode active matrix type liquid crystal display device further includes an interlayer insulating layer formed in a layer located immediately below the common electrode, and a common auxiliary electrode comprised of a single or a plurality of layer(s) formed below the interlayer insulating layer, wherein the common auxiliary electrode is electrically connected to the common electrode lines, and kept at a voltage equal to a voltage of the common electrode, and the common auxiliary electrode is composed of opaque metal.

It would be possible to form storage capacitors both above and below a pixel by electrically connecting the common electrode to each other, similarly to the common auxiliary electrodes, ensuring higher storage capacitance and higher quality in

displaying images.

It is preferable that the pixel auxiliary electrode is formed below the common electrode having a plurality of comb-teeth.

It would be possible to electrically connect the common auxiliary electrodes located at opposite sides of a pixel, to each other without much reduction in an efficiency at which a light is used, by locating the common auxiliary electrode composed of opaque material, just below the pixel electrode having a slightly smaller transmissivity than that of the common auxiliary electrode. However, if the pixel auxiliary electrode were arranged below the common electrode, an electric field would be generated between the common electrode and the pixel auxiliary electrode, resulting in that a desired horizontal electric field cannot be applied to liquid crystal. Accordingly, it is preferable that the pixel auxiliary electrode is arranged just below the pixel electrode, and the common auxiliary electrode is arranged just below the common electrode.

It is preferable that a scanning line terminal, a data line terminal and a common electrode line terminal are covered with or composed of a material of which the common electrode comprised of transparent electrodes are composed.

This ensures it possible to form the common electrode concurrently with terminals of the liquid crystal display device, avoiding an increase in the fabrication steps necessary for forming the common electrode.

The in-plane switching mode active matrix type liquid crystal display device may preferably further includes a reverse-rotation preventing structure in a sub pixel area in which all liquid crystal molecules are rotated in the same direction, for preventing liquid crystal molecules from rotating in a direction opposite to the same direction, wherein at least a part of edges of the pixel auxiliary electrodes and the

common electrode lines is formed oblique such that an initial alignment orientation of liquid crystal molecules overlaps a direction of an electric field generated in the sub pixel area in all sub-areas in the sub pixel areas, if the initial alignment orientation rotates by an acute angle.

By preventing molecular axes of liquid crystal molecules from rotating in a reverse direction, it would be possible for the liquid crystal display device to have improved display quality and reliability.

It is preferable that the in-plane switching mode active matrix type liquid crystal display device further includes a passivation film covering the common electrode therewith.

It is preferable that the in-plane switching mode active matrix type liquid crystal display device further includes a passivation film covering the pixel electrode therewith.

The passivation film covering the pixel or common electrode therewith would relax an intensive electric field generated at edges of the pixel or common electrode, ensuring prevention of defects in both alignment of liquid crystal molecules and displaying images.

It is preferable that the first substrate is formed with one of a first contact hole electrically connecting the pixel electrode to the source electrode, and a second contact hole electrically connecting the common electrode to the common electrode lines, the first and second contact holes being covered at inner surfaces thereof with a metal film.

By covering the first and second contact holes at its inner surfaces with a metal film, it would be possible to reduce a resistance between the common electrode and the common electrode line both composed of a transparent metal, and enhance uniformity in displaying images.

For instance, the pixel electrode may be formed of a second metal layer of which

the data lines are formed.

Since the pixel and common electrodes are comprised of different layers from each other, the pixel and common electrodes are no longer short-circuited with each other, ensuring enhancement in a fabrication yield.

It is preferable that the pixel electrode is formed of a second metal layer of which the drain electrode is formed, in an area in which an image is displayed, and a portion of the common electrode other than a portion composed of transparent metal and overlapping the data lines is formed of a first metal layer of which the gate electrode is formed.

Since the pixel and common electrodes are comprised of different layers from each other, the pixel and common electrodes are no longer short-circuited with each other, ensuring enhancement in a fabrication yield. In addition, since the floating electrode comprised of the first layer is comprised of a layer of which the common electrode is also comprised, the floating electrode becomes a fixed electrode by electrically connecting to the common electrode, ensuring enhancement in display quality.

It is preferable that the in-plane switching mode active matrix type liquid crystal display device further includes an interlayer insulating film sandwiched between the data lines and the common electrode overlapping the data lines and composed of transparent metal, the interlayer insulating film being formed only below the common electrode.

This ensures that it is no longer necessary to form an interlayer insulating film between the common electrode and the data line in an area which is large more than necessary, and hence, the data line can be almost entirely covered with the common electrode without an increase in a parasitic capacity between the common electrode and

the data line.

It is preferable that the in-plane switching mode active matrix type liquid crystal display device further includes an interlayer insulating film sandwiched between the data lines and the common electrode overlapping the data lines and composed of transparent metal, the interlayer insulating film being comprised of an inorganic film.

By composing the interlayer insulating film of an inorganic material, the interlayer insulating film could have enhanced transparency. In addition, it would be possible to enhance reliability of the thin film transistor.

It is preferable that the in-plane switching mode active matrix type liquid crystal display device further includes an interlayer insulating film sandwiched between the data lines and the common electrode overlapping the data lines and composed of transparent metal, the interlayer insulating film being comprised of an organic film.

Since an organic film has a smaller dielectric constant than that of an inorganic film, the interlayer insulating film composed of organic material would have a smaller dielectric constant than that of an interlayer insulating film composed of inorganic material. In addition, a process of composing an interlay insulating film of an organic material is simpler than a process of composing the same of an inorganic material.

It is preferable that the in-plane switching mode active matrix type liquid crystal display device further includes an interlayer insulating film sandwiched between the data lines and the common electrode overlapping the data lines and composed of transparent metal, the interlayer insulating film being comprised of a first film comprised of an inorganic film and a second film comprised of an organic film and covering the first film therewith.

In comparison with an interlayer insulating film comprised only of an inorganic film, an interlayer insulating film having such a multi-layered structure could have a

smaller dielectric constant. In addition, by designing the first film comprised of an inorganic film to make contact with a semiconductor layer in the thin film transistor, and further by forming the second film on the first film, it would be possible to form a stable interface between the first and second films, ensuring enhancement in reliability of the thin film transistor.

What is Claimed is:

1. A transverse electric field type LCD comprising:

a first substrate and a second substrate;

a data electrode, common electrode and common electrode lines all being formed on the first substrate;

a first gate-insulating layer formed thoroughly on the first substrate over the data electrode and the common electrode and has data holes formed within the data electrode;

a storage electrode formed on the gate-insulating layer to overlap over the common electrode lines or the common electrodes;

a second gate-insulating layer formed thoroughly on the first substrate over the storage electrode, having a hole formed at the same position corresponding to the data holes and a storage hole formed within the storage electrode area;

a connection electrode formed on the protective film to cover the data and storage holes formed thereon and electrically connecting between the data electrode and the storage electrode; and,

a liquid crystal layer formed between the first and the second substrates.

2. The device of claim 1, wherein the data electrode and the common electrode are composed of the same material.

3. The device of claim 1, wherein distances between the data electrode and the common electrode are in regular form.

4. The device of claim 1, wherein the connective electrode is composed of an indium tin oxide (ITO).

5. The device of claim 1, wherein at least one of the storage electrodes is overlapped with the common bus lines, and at least one of the storage electrodes except for the one being overlapped with the common bus lines is formed integrally with the drain electrode to be partially overlapped with the common electrode.

6. A transverse electric field type LCD comprising:

a first substrate and a second substrate;

a data electrode, common electrode and common electrode lines all being formed on the first substrate;

a first gate-insulating layer formed thoroughly on the first substrate over the data electrode and the common electrode and has data holes formed within the data electrode;

a second gate-insulating layer formed over the first gate-insulating layer and has a hole at the same position of the data hole;

a connective electrode formed to partially overlap the common electrode and the common bus lines and formed on the second gate-insulating layer so as to cover the data hole; and,

a liquid crystal layer sandwiched between the first and the second substrates.

7. The device of claim 6, wherein the data electrode and the common electrode are composed of the same material.

8. The device of claim 6, further comprising:

a thin film transistor including a drain electrode formed between the first and the second gate-insulating layer; and

contact holes formed on the second gate-insulating layer within the drain electrode;

wherein,

the connective electrode is formed to cover the contact holes to be connected to the drain electrode.

9. The device of claim 6, wherein the connective electrode is composed of a transparent material such as an indium tin oxide (ITO).

10. A transverse electric field type LCD comprising:

a first substrate and a second substrate;

a data electrode, common electrode and common electrode lines all being formed on the first substrate;

a first gate-insulating layer formed thoroughly on the first substrate over the data electrode and the common electrode and has data holes formed within the data electrode;

a storage electrode formed on the gate-insulating layer to overlap over the common electrode lines or the common electrodes and covers the data holes to be connected to the data electrode; and,

a liquid crystal layer sandwiched between the first and the second substrates.

11. The device of claim 10, wherein the data electrode and the common electrode

are composed of the same material.

12. The device of claim 10, further comprising:

a thin film transistor including a drain electrode formed between the first and the second gate-insulating layer; and

a set of storage electrodes;

wherein,

one of the storage electrodes is overlapped with the common bus lines, and the other one is formed integrally with the drain electrode to be partially overlapped with the common electrode.

13. The device of claim 10, wherein a redundancy electrode is formed within the data hole area.

14. The device of claim 13, wherein the redundancy electrode is composed of an indium tin oxide (ITO).

15. The device of claim 13, wherein the redundancy electrode is sandwiched between the first gate-insulating layer and the storage electrode.

16. The device of claim 13, wherein the redundancy electrode is formed over the storage electrode.

17. A traverse electric field type liquid crystal display device generating two-directional electric fields almost parallel with a surface of a substrate based on data

electrodes and common electrodes formed on the substrate, wherein the data electrodes and the common electrodes are composed of the same material.

18. The device of claim 17, wherein distances between the data electrodes and the common electrodes are in regular form.

19. A method of fabricating a traverse electric field type liquid crystal display device comprising steps of:

forming a first and a second substrate;

forming common bus lines, common electrodes and data electrode by patterning the first substrate on which a transparent metallic film is deposited;

forming a first gate-insulating layer thereover;

depositing another transparent metallic film on the first substrate on which the gate-insulating layer is applied, patterning the same and forming a storage electrode thereafter;

forming a second gate-insulating layer thereover;

etching partially the storage electrode area of the second gate-insulating layer to form the storage hole and thereafter etching partially the data electrodes of the first and the second gate-insulating layers to form data holes;

depositing electricity conductive material on the second gate-insulating layer, patterning the same to form a connective electrode for covering the data holes and the storage holes; and

forming a liquid crystal layer by injecting liquid crystal between the first and the second substrates.

20. The device of claim 19, wherein the electricity conductive material is an indium tin oxide (ITO).

DRAWING

FIG. 1

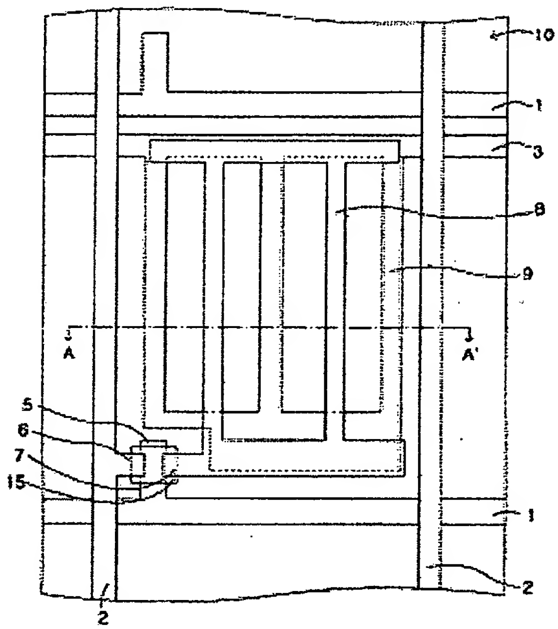


FIG. 2

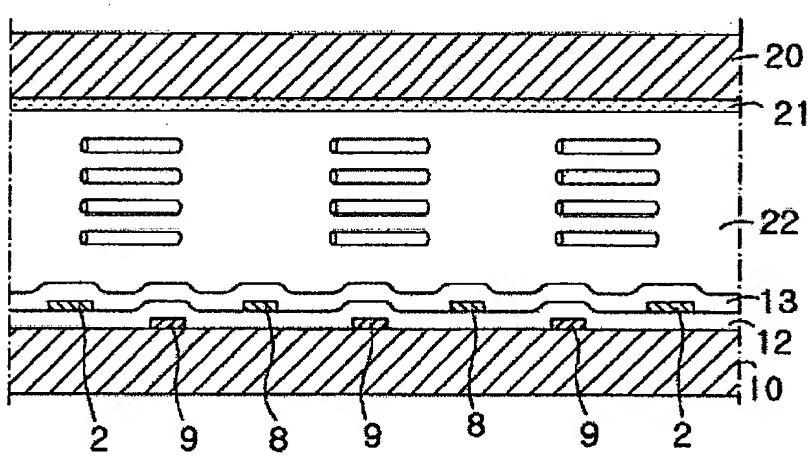
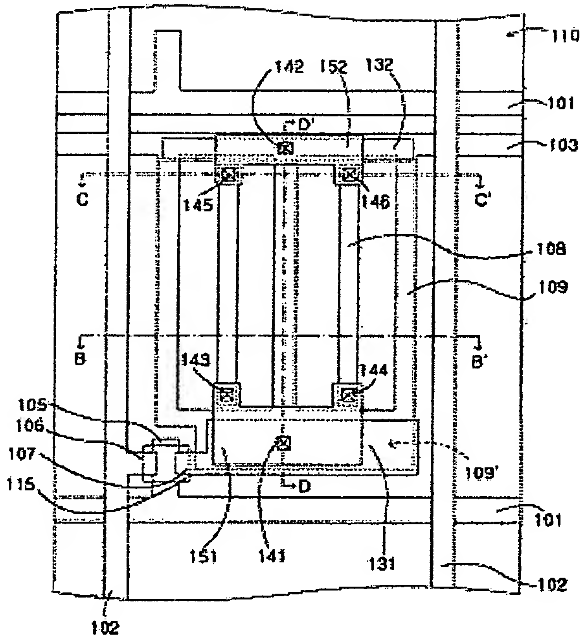


FIG. 3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109'
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141
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102
102

FIG. 4

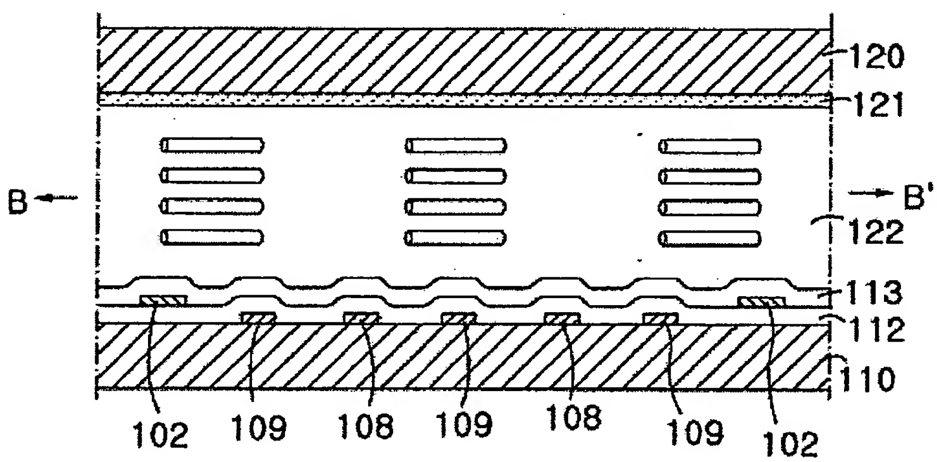
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FIG. 5

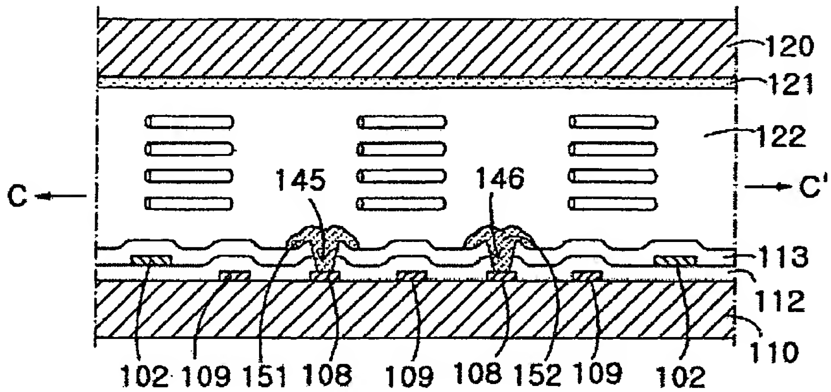
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FIG. 6

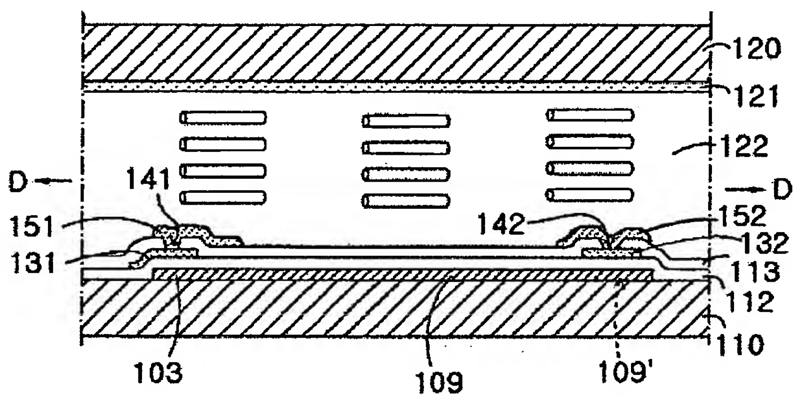
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FIG. 7

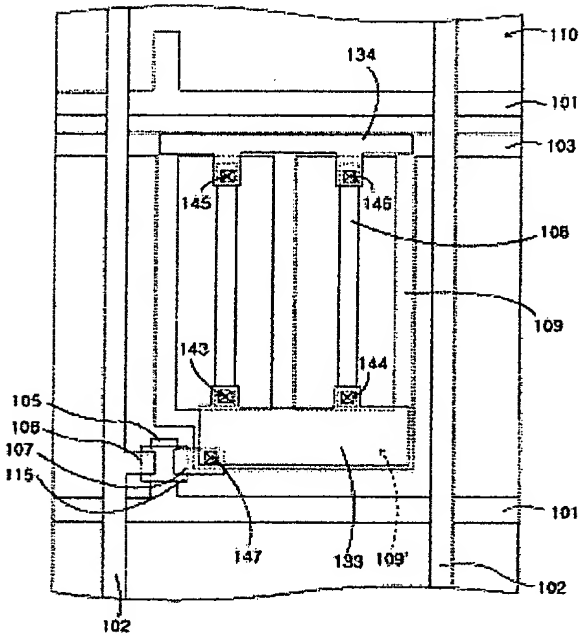
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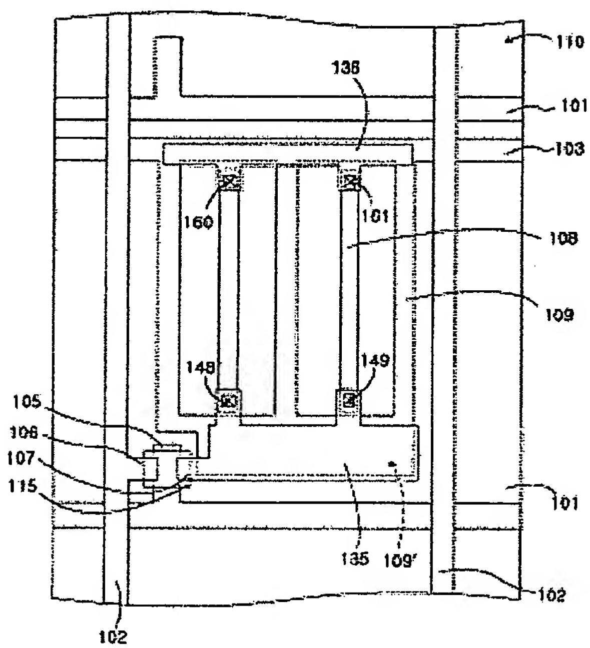
FIG. 8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